SURPLUS AGRICULTURAL LABOUR AND THE DEVELOPMENT OF A DUAL ECONOMY

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I. Introduction

THE point of departure for this paper is the well-established empirical association between the degree of industrialization and the level of economic development. This association characterizes both time series data for individual countries and international cross-sections at a given point of time. High income per head is associated with a relatively large proportion of the total population engaged in industry. Low income per head is associated with a predominance of employment in the agricultural sector. The process of economic development may be studied as an increase in income per head or as an increase in the role of industrial activity relative to that in agriculture. Quantitatively speaking, gross domestic product *per capita* for the world excluding centrally planned economies increased from $334 to $534 in U.S. dollars of 1958 between 1938 and 1961. In the same period value added in industrial activity increased from $117 to $223. Similarly, in 1961 gross domestic product *per capita* for industrialized countries was $1,486 U.S. dollars of 1958; the corresponding figure for less industrialized countries was $132 *per capita.* Value added in industry *per capita* was $666 for industrialized countries and $36 for less industrialized countries.[1] For both time series and cross-sections high levels of output are associated with a high degree of industrialization.

The great disparity in degree of industrialization in developed and less developed countries is mirrored by a bifurcation in theories of economic growth. In models of a developed economy the analysis is concentrated on the allocation of national product between consumption and investment. Technology may be characterized by fixed factor proportions, as in Harrod's model of economic growth, or by variable factor proportions, as

[1] Statistical Office of the United Nations, Department of Economic and Social Affairs, *The Growth of World Industry, 1938–1961, International Analyses and Tables*, New York, United Nations, 1965, pp. 194–5. For more detailed support of the association between degree of industrialization and the level of economic development for time series, the following may be consulted: F. Dovring, 'The share of agriculture in a growing population', *Monthly Bulletin of Agricultural Economics and Statistics*, 8 (1959), pp. 1–11, reprinted in Carl K. Eicher and Lawrence W. Witt (eds.), *Agriculture in Economic Development*. New York: McGraw-Hill, 1964, pp. 78–98; S. Kuznets, 'Quantitative aspects of the economic growth of nations, II. Industrial distribution of national product and labor force', *Economic Development and Cultural Change*, 5, Supplement (1957). Similar support for the association on international cross-sections may be obtained from: C. Clark, *The Conditions of Economic Progress*, 3rd ed. London: Macmillan, 1957; H. B. Chenery, 'Patterns of industrial growth', *American Economic Review*, 50 (1960), pp. 624–54; Centre for Industrial Development, Department of Social and Economic Affairs, *A Study of Industrial Growth*, New York, United Nations, 1965.

in Tinbergen's model.[1] Technological change may be embodied or disembodied, neutral or biased. Similarly, the model may be closed by assuming that investment is a constant fraction of national output or that investment depends on the distribution of income as in Kaldor's theory of economic growth.[2] For present purposes the similarities of theories of growth for an advanced economic system are more important than the differences. The industrial composition of output, that is, the proportion of output generated by industry, by agriculture, and by the remaining sectors of the economy, is entirely ignored. The central feature of the process of increasing income *per capita*, namely, an increase in the role of industry relative to that of agriculture, is left entirely out of account.

By contrast, in models of a less developed economy the analysis is concentrated on the relationship between the growth of income and the growth of population. One branch of the modern literature on theories of development originated with the paper 'Economic Development with Unlimited Supplies of Labour', by W. A. Lewis.[3] Lewis postulates that the fundamental characteristic of certain less developed economies is the existence of disguised unemployment. Lewis's analysis of the role of the unemployed in the determination of wages during economic development is strictly analogous to that of Marx. Wages are tied to a subsistence level so that agricultural output *per capita* remains constant so long as disguised unemployment persists. A second branch of the modern theory of development originates with Harvey Leibenstein's book of 1954.[4] The central result of Leibenstein's theory is the existence of a low-level equilibrium trap, a kind of Malthusian equilibrium of population and sustenance. The Malthusian equilibrium level of income is stable for small changes in income; to achieve sustained economic growth something like a massive infusion of capital is required. As in theories of economic growth, the industrial composition of output is entirely ignored in theories of economic development.

[1] R. F. Harrod, 'An essay in dynamic theory', *Economic Journal*, 49 (1939), pp. 14–33; J. Tinbergen, 'Zur Theorie der langfristigen Wirtschaftsentwicklung', *Weltwirtschaftliches Archiv*, 55 Band (1942), pp. 511–49, translated and reprinted as 'On the theory of trend movements', in L. H. Klaasen, L. M. Koyck, and H. J. Witteveen (eds.), *Jan Tinbergen Selected Papers*, Amsterdam, North Holland, 1959, pp. 182–221.

[2] N. Kaldor, 'A model of economic growth', *Economic Journal*, 67 (1957), pp. 591–624, reprinted in *Essays in Economic Stability and Growth*. Glencoe: Free Press, 1960, pp. 259–300; N. Kaldor, 'Capital accumulation and economic growth', in F. A. Lutz and D. C. Hague (eds.), *The Theory of Capital*. London: Macmillan, 1961, pp. 177-222; N. Kaldor and J. Mirrlees, 'A new model of economic growth', *Review of Economic Studies*, 29 (1962), pp. 172–92.

[3] W. A. Lewis, 'Economic development with unlimited supplies of labour', *The Manchester School*, 22 (1954), pp. 139–91; W. A. Lewis, 'Unlimited labour: further notes', *The Manchester School*, 26 (1958), pp. 1–32.

[4] H. Leibenstein, *A Theory of Economic-Demographic Development*. Princeton: Princeton University Press, 1954; see also: H. Leibenstein, *Economic Backwardness and Economic Growth*. New York: Wiley, 1957.

It is widely recognized that under contemporary conditions many less developed countries have important relations with developed countries either through international trade or through the establishment of a modern 'enclave' in an otherwise purely traditional social and economic setting.[1] Either relationship gives rise to economic and social 'dualism' in which a given economic or social system consists of two component parts—an advanced or modern sector and a less advanced or traditional sector. To capture the essence of dualistic development it is necessary to focus on the association between the degree of industrialization and the level of economic development. A theory of development of a dual economy requires a theory of the industrial composition of output and its relationship to the level of economic development. The process of economic development must be studied as an increase in the role of industrial activity relative to that in agriculture. In the development of a dual economy these two developments are intimately related.

The purpose of this paper is to present a theory of development of a dual economy, focusing on the relationship between the degree of industrialization and the level of economic development. The theory of development of a dual economy has been approached within both classical and neo-classical frameworks. The chief difference between these two approaches to the development of a dual economy is in conditions governing the supply of labour to the industrial sector. In the classical approach to the theory, the real-wage rate is assumed to be fixed in terms of agricultural goods; from the point of view of industry labour is available in unlimited amounts at a fixed real wage. In the neo-classical approach labour is never available to the industrial sector without sacrificing agricultural output. From the point of view of the industrial sector the real-wage rate rises steadily over time, depending on the rates of technological progress in both sectors and the rate of capital accumulation. Disguised unemployment is assumed to be non-existent. As Lewis points out, a phase of development characterized by disguised unemployment may be followed by a phase without unemployment: 'When the labour surplus disappears our model of the closed economy no longer holds. Wages are no longer tied to a subsistence level.'[2] Within both frameworks it is possible to examine aspects of industrialization of strategic importance for developing countries such as changes in the structure of output and

[1] This point of view is elaborated in my paper, 'The development of a dual economy', *Economic Journal*, 71 (1961), especially pp. 309–11. The same point of view is expressed by Luigi Spaventa, 'Dualism in economic growth', *Banca Nazionale Del Lavoro, Quarterly Review*, 51 (1959), especially pp. 386–90. An excellent review of the literature on economic dualism through 1960 is given by Howard S. Ellis, 'Las economías duales y el progreso', *Revista de Economía Latinoamericana* (1961), pp. 3–17.

[2] Lewis, 1954, p. 176.

employment and changes in the rate of investment, capital intensity, and factor substitution.

II. Development of a dual economy: a classical approach

In presenting the classical approach to the theory of development of a dual economy the essential assumption proposed by Lewis, unlimited supplies of labour at a fixed real-wage rate, will be retained. In the theory of development of a dual economy, the economic system may be divided into two sectors—the advanced or modern sector, which we will call, somewhat inaccurately, the industrial sector or manufacturing, and the backward or traditional sector, which may be suggestively denoted agriculture. This terminology has been used by Lewis and by Fei and Ranis as well as by the present author.[1] It is clear that industry includes a good many traditional activities and that these activities have many of the characteristics of the backward sector; similarly, the agricultural sector may include a relatively advanced sub-sector. Examples of the former would include small-scale industry in Japan; examples of the latter would include plantation agriculture in Asia and agriculture in areas of European settlement in parts of Africa. Nevertheless, it is useful to regard the backward sector as mainly agricultural and the advanced sector as primarily industrial.

Productive activity in each sector may be characterized by a function relating output to each of the factors of production—land, labour, and capital. The special character of the theory of development of a dual economy is an asymmetry in the productive relations. The output of the traditional sector is a function of land and labour alone; there is no accumulation of capital except in the form of land reclamation. This assumption is made by the present author and also by Lewis and by Fei and Ranis.[2] Of course, other assumptions are possible. Even in relatively primitive societies, there are important uses of capital in agricultural production.[3] Capital is accumulated in the form of land reclamation and in the form of equipment for agriculture, fishing, and hunting. In the study of primitive societies, saving and investment, ownership of property, and even credit cannot be ignored. For present purposes, the assumption of no capital in agriculture is useful. The essential distinction is between agriculture which uses capital produced in the advanced or modern sector and agriculture which uses only traditional forms of capital. We will refer to an

[1] Lewis, 1954, pp. 146–8; Jorgenson, 1961, p. 311; J. C. H. Fei and G. Ranis, 'A theory of economic development', *American Economic Review*, 51 (1961), pp. 533–4.

[2] Lewis, 1954, p. 146; Jorgenson, 1961, p. 311; J. C. H. Fei and G. Ranis, *Development of the Labor Surplus Economy*. Homewood: Irwin, 1964, p. 16.

[3] See, for example, the essays in R. Firth and B. S. Yames (eds.), *Capital, Saving and Credit in Peasant Societies*. Chicago: Aldine, 1964.

agricultural sector utilizing modern forms of capital as commercialized agriculture. For present purposes the special role of commercialized agriculture will be ignored. The resulting theory of development of a dual economy is of special relevance to the less developed countries.

It will be assumed that land is fixed in supply. Further, it is assumed that agricultural activity is characterized by constant returns to scale with all factors variable. These assumptions are made by the present author and by Fei and Ranis.[1] Although there are many ways to account for diminishing returns, e.g. declining quality of land as more and more is put under cultivation as in Ricardo's extensive margin—the initial assumption that land is fixed in supply implies that the diminishing returns arise at the intensive margin of the Ricardian scheme. In the neo-classical theory of development of a dual economy it is assumed that the marginal productivity of labour in agriculture is always positive. In the classical theory it is assumed that there is some point at which the marginal productivity of-labour becomes zero. If population exceeds the quantity at which the marginal productivity of labour becomes zero, labour is available to the manufacturing sector without loss of agricultural output. This assumption, made by Lewis and by Fei and Ranis,[2] will be retained in the present version of the classical theory of development of a dual economy.

Land does not appear as a factor of production in the manufacturing sector; the level of manufacturing output is a function of capital and labour alone. In manufacturing, expansion of productive activity proceeds with constant returns to scale. This appears to be a reasonable assumption, at least on the basis of evidence from the manufacturing industries of advanced economies.[3] A second feature of the production functions for agriculture and manufacturing is that each function will shift over time so that a given bundle of factors will generate a higher level of output at one date than at an earlier date. In short, technological change will be assumed to take place in the manner indicated by Tinbergen and other contributors to the neo-classical theory of economic growth. A special problem arises in applying this assumption to the classical theory of development of a dual economy. For simplicity, it will be assumed that the size of labour force for which the marginal productivity of labour becomes zero remains the same for all technological changes. Of course, the output of the agricultural sector at this point increases over time as the agricultural production function shifts upward.

In the classical approach to the theory of development of a dual economy population growth is ignored or shunted aside as a qualification to the main

[1] Jorgenson, 1961, p. 311; Fei and Ranis, 1964, pp. 15–16.

[2] Lewis, 1954, p. 141; J. C. H. Fei and G. Ranis, 'Unlimited supply of labour and the concept of balanced growth', *Pakistan Development Review*, 1 (1961), p. 30.

[3] See Jorgenson, 1961, p. 311, and the references given there.

argument. Lewis discusses a demographic theory quite similar to that of Leibenstein, as outlined above. However, this demographic theory is not integrated into the theory of economic development in a satisfactory way. For Lewis's main line of argument it suffices to assume that unlimited quantities of labour are available to the industrial sector at a fixed real wage; an unlimited supply of labour may have its origin in population growth, but population growth is not affected by activity in either the agricultural or industrial sectors until the phase of disguised unemployment is completed. A similar assumption is made by Fei and Ranis: 'Population growth will be treated as a known phenomenon exogenous to our model.'[1] This assumption must be qualified in that so long as the real wage remains fixed, the consumption of workers consists entirely of products of the agricultural sector. In the words of Fei and Ranis: '... as a consequence of the natural austerity condition arising from the same unlimited supply of labor situation, much industrial output must take the form of capital goods due to the absence of a domestic market for consumer goods.'[2] For simplicity, it will be assumed that so long as there is disguised unemployment, population expands at the same rate as the growth of agricultural output. This is the only assumption which is consistent with the view of Lewis and of Fei and Ranis that the real-wage rate remains fixed and equal to the initial level of real income in the agricultural sector. At this level of income all of the income of workers in either sector is used for consumption of agricultural products.

The chief difference between the classical approach to the development of a dual economy and the neo-classical approach is in the conditions governing the supply of labour. In the classical theory, labour is available to the industrial sector in unlimited quantities at a fixed real-wage rate, measured in agricultural goods. Lewis suggests that it is immaterial to his argument whether the marginal productivity of labour in agriculture is zero or simply less than the real-wage rate.[3] Fei and Ranis distinguish between phases of development in which the marginal productivity of labour is zero and in which the marginal productivity of labour is positive but less than the real wage.[4] In the first of these phases labour may be supplied to the industrial sector at no loss in agricultural output; in the second of these phases, labour may be supplied to the industrial sector only at some sacrifice in agricultural output. In both phases labour is available to the industrial sector at a fixed real-wage rate only if the terms of trade between agriculture and industry remain fixed and if population growth is precisely equal to the growth of agricultural output. If the terms of trade

[1] Fei and Ranis, 'A theory of economic development', 1961, p. 550.
[2] Fei and Ranis, *Development of a Labor Surplus Economy*, 1964, p. 118.
[3] Lewis, 1954, p. 142.
[4] Fei and Ranis, 'A theory of economic development', 1961, p. 537.

should turn against industry, a constant real wage (measured in agricultural goods) will imply a rising price of labour relative to the price of industrial goods.

Finally, in the present version of the classical approach to the development of a dual economy, it will be assumed that saving is equal to total profits in the industrial sector. This assumption is consistent with Lewis's observation that: 'We have seen that if unlimited labour is available at a constant real wage, the capitalist surplus will rise continuously, and annual investment will be a rising proportion of the national income.'[1] As Lewis emphasizes: 'Practically all saving is done by people who receive profits or rents. Workers' savings are very small.'[2] The present assumption implies that agricultural rents, in so far as they exist at all, are exchanged for goods produced by the industrial sector. The agricultural products represented by these rents are then provided to the industrial workers. The institutional mechanism by which this transaction takes place may vary from one economy to another. For example, agricultural rents may be taxed away and the proceeds spent on governmentally financed investment; alternatively, landlords may themselves invest in the industrial sector, becoming industrial capitalists; finally, landlords may consume goods produced by the industrial sector so that all investment is done by the owners of industrial capital. For present purposes it suffices to assume that saving is equal to total profits in the industrial sector without specifying whether the resulting accumulation of capital is owned by the government, the landlords, or the industrial capitalists.

We are now in a position to lay out a more concrete version of the classical approach to the development of a dual economy. To begin the analysis we consider an economic system in which no development of manufacturing activity has taken place; all productive activity is concentrated in the traditional or backward sector. We will assume that there is some maximum quantity of labour which may be employed in the agricultural sector with positive marginal productivity; the agricultural labour force, say A, is always less than this maximum quantity of labour. If we let Y be the level of agricultural output and L the fixed quantity of land available to the economy, then a simple version of the production function for agriculture, characterized by constant returns to scale with all factors variable, is given by the Cobb–Douglas function:

$$Y = e^{\alpha t} L^{\beta} A^{1-\beta},$$

where $e^{\alpha t}$ represents the shift factor corresponding to technological progress. Changes in techniques are assumed to take place at a constant percentage rate, α. The constant β represents the elasticity of output with

[1] Lewis, 1954, p. 171. [2] Lewis, 1954, p. 157.

respect to an increase in the supply of land; if the supply of land is fixed it is possible to choose the origin for measuring the passage of time so that the production function can be rewritten in the simpler form:

$$Y = e^{\alpha t}A^{1-\beta}.$$

For a total population in excess of the maximum quantity which may be employed at positive marginal productivity, we may distinguish between the labour force employed at positive marginal productivity, say A, the agricultural labour force, and the labour force which is redundant, say R. Then total population is the sum of the agricultural labour force and redundant labour:

$$P = A+R.$$

If we represent the maximum labour force which may be employed at positive marginal productivity by A^+, then the agricultural labour force is the minimum of total population and this maximum labour force:

$$A = \min\begin{cases} P \\ A^+ \end{cases}.$$

Of course, if the agricultural labour force is equal to total population, disguised unemployment is zero: if the agricultural labour force is equal to the maximum level, A^+, redundant labour is equal to the difference between total population and this maximum level.

Under the assumptions that the rate of technological progress in agriculture is positive and that the maximum quantity of labour which may be employed with positive marginal productivity is fixed over time, the development of an economy in which all productive activity is concentrated in the traditional or backward sector is simple to describe. At a constant real-wage rate, measured in agricultural goods, population increases at the same rate as agricultural output. In the presence of redundant labour, the rate of growth of agricultural output and population is constant and equal to the rate of technological progress in agriculture, α. In the absence of redundant labour, population growth can exceed the rate of technological progress since the rate of growth of output is equal to the rate of technological progress, α, plus the elasticity of output with respect to labour, $1-\beta$, multiplied by the rate of growth of population. With a constant real-wage rate the rate of growth of population is simply α/β, a positive quantity. Hence, in an economy in which there is no redundant labour initially, population will grow at a positive rate until the maximum quantity of labour which can be employed with positive marginal productivity is reached. After this point the rate of population growth will slow to the rate of technological progress, α, and all increments in population will become part of the redundant labour force.

We next consider an economic system in which development of manufacturing activity has taken place. Conditions of production in the manufacturing sector must be described. We have assumed that the production function in manufacturing exhibits constant returns to scale. We have also assumed that the output of manufactured goods for a given bundle of capital and labour increases over time. If we denote the quantity of manufacturing output by X, the manufacturing labour force by M, and the quantity of capital by K, then a simple version of the production function for manufacturing is given by the Cobb–Douglas function:

$$X = e^{\lambda t} K^{\sigma} M^{1-\sigma},$$

where $e^{\lambda t}$ represents technological change, as before, and the constant σ represents the elasticity of manufacturing output with respect to an increase in the supply of land.

With respect to the supply of labour to the manufacturing sector, we have assumed that redundant labour is available to the industrial sector at a fixed real wage, measured in agricultural goods. We may also assume that the terms of trade between agriculture and manufacturing are fixed. If we assume further that competitive conditions prevail in manufacturing, the marginal product of labour is equal to the fixed real wage, measured in either agricultural or manufacturing goods. This assumption is made by Lewis and by Fei and Ranis.[1] If we denote the fixed real wage measured in manufactured goods by w, the marginal product of labour in the manufacturing sector is then:

$$\frac{\partial X}{\partial M} = (1-\sigma)\frac{X}{M} = w.$$

If there is no redundant labour, the marginal productivity of labour in the agricultural sector may still be below the real-wage rate, measured in agricultural goods. However, labour may be transferred from the agricultural sector to the industrial sector only by sacrificing agricultural output. Under these conditions it may still be assumed that the terms of trade between agriculture and manufacturing are fixed. This assumption is made by Lewis.[2] Alternatively, it may be assumed that the terms of trade turn against manufacturing, so that the wage rate measured in manufactured goods increases. This assumption is made by Fei and Ranis.[3] In the present version of the classical approach to the theory of development of a dual economy, the terms of trade between agriculture and manufacturing cannot be determined endogenously. For simplicity, we will begin with Lewis's assumption that the terms of trade are fixed; under this assumption the marginal product of labour in manufacturing is fixed.

[1] Lewis, 1954, pp. 146–9; Fei and Ranis, 1964, pp. 16–19.

[2] Lewis, 1954, p. 142.

[3] Fei and Ranis, 1964, p. 209.

Using the marginal productivity relationship given above to eliminate the manufacturing labour force from the production function for manufacturing, we may write:

$$X = \left(\frac{1-\sigma}{w}\right)^{(1-\sigma)/\sigma} e^{(\lambda/\sigma)t} K.$$

If we assume that saving is equal to the share of profits in the industrial sector, ignoring depreciation we may set the rate of change of capital equal to the share of profits in manufacturing output:

$$\dot{K} = \sigma X,$$

so that the rate of growth of capital may be written:

$$\frac{\dot{K}}{K} = \sigma\left(\frac{1-\sigma}{w}\right)^{(1-\sigma)/\sigma} e^{(\lambda/\sigma)t}.$$

Using the production function and the fact that the output per man remains constant, the rate of growth of manufacturing output may be written:

$$\frac{\dot{X}}{X} = \frac{\lambda}{\sigma}+\sigma\left(\frac{1-\sigma}{w}\right)^{(1-\sigma)/\sigma} e^{(\lambda/\sigma)t}.$$

The rate of growth of manufacturing employment is, of course, equal to the rate of growth of manufacturing output.

For an economy with total population in excess of the maximum quantity which may be employed at a positive marginal productivity in agriculture plus the manufacturing labour force, there is redundant labour. Total population is the sum of the agricultural labour force, the industrial labour force, and redundant labour:

$$P = A+M+R.$$

The agricultural labour force is the minimum of total population less the manufacturing labour force and the maximum labour force which may be employed at positive marginal productivity:

$$A = \min\begin{cases} P-M \\ A^{+} \end{cases}.$$

So long as there is redundant labour in the agricultural sector, manufacturing output and manufacturing employment grow at a rate which is positive and increasing. Capital in manufacturing also grows at a rate which is positive and increasing, but always less than the rate of growth of output. This implies that the capital-output ratio is always falling; a similar result is obtained by Fei and Ranis.[1] Since agricultural output is increasing at a constant rate, equal to the rate of technological progress in agriculture, population is increasing at this same rate. Whatever the initial value of

[1] J. C. H. Fei and G. Ranis, 'Capital accumulation and economic development', *American Economic Review*, 53 (1963), p. 288.

the rate of growth of manufacturing output, this rate of growth eventually exceeds any fixed rate of growth. The sum of redundant labour and manufacturing employment grows at a rate which exceeds the rate of growth of population; but this rate must fall to the rate of growth of population. Hence, the rate of growth of manufacturing employment eventually becomes so large as to force the rate of growth of redundant labour to become negative and decreasing. Under these conditions redundant labour eventually disappears altogether. This concludes the description of the first phase of development with unlimited supplies of labour. The point at which redundant labour disappears is called the 'Lewis turning-point' by Fei and Ranis.[1]

After the Lewis turning-point is reached the marginal productivity of labour in the agricultural sector is positive but less than the real-wage rate, measured in agricultural goods. Under the assumption that the real-wage rate remains fixed when measured in agricultural goods, the rate of growth of population is equal to the rate of technological change in the agricultural sector less the elasticity of agricultural output with respect to labour multiplied by the rate of decline of the agricultural labour force. Where w_A is the proportion of the agricultural labour force in total population and w_M the proportion of the manufacturing labour force, this condition on the rate of population growth implies:

$$\alpha+(1-\beta)\frac{\dot{A}}{A} = w_A\frac{\dot{A}}{A}+w_M\frac{\dot{M}}{M},$$

or, simply:

$$\alpha+(w_M-\beta)\frac{\dot{A}}{A} = w_M\frac{\dot{M}}{M}.$$

For this condition to be satisfied, the manufacturing proportion, w_M, must be such that the rate of growth of the agricultural labour force is negative at the Lewis turning-point. Furthermore, the rate of growth of the agricultural labour force must remain negative until the labour force itself reaches the level at which the marginal product of labour in agriculture, measured in agricultural goods, is equal to the real wage. For this it suffices to assume that the share of manufacturing in the total labour force exceeds the elasticity of agricultural output with respect to land. Under this condition the agricultural labour force declines at an increasing rate until the marginal product of labour is equal to the real wage. At this point a third phase of the development of a dual economy is reached. In this phase the wage rate of labour is the same in agriculture and in manufacturing.

The third phase of development of a dual economy under the classical approach is described by Lewis as follows: 'When capital catches up with

[1] Fei and Ranis, 'A theory of economic development', 1961, p. 540.

labour supply, an economy enters upon the [third] phase of development. Classical economics ceases to apply; we are in the world of neo-classical economics, where all the factors of production are scarce, in the sense that their supply is inelastic. Wages are no longer constant as accumulation proceeds; the benefits of improved technology do not all accrue to profits; and the profit margin does not necessarily increase all the time. . . .'[1] Fei and Ranis describe the third phase as follows: 'The transition into phase [three] constitutes a major landmark in the developmental process. With the completion of the transfer of the disguisedly unemployed, there will occur a switch, forced by circumstance in employer behavior, i.e., the advent of a fully commercialized agricultural sector. This landmark may be defined as the end of the take-off process. We know of no other way to establish a nonarbitrary criterion for an economy reaching the threshold of so-called self-sustaining growth.'[2] The basic point made by Lewis and by Fei and Ranis is that a neo-classical theory of growth for an advanced economy applies after the third phase of development has been reached. Hence, further discussion of this phase will be postponed until the neo-classical theory of development for a dual economy has been discussed.

Parenthetically, it should be remarked that Fei and Ranis attempt to combine Lewis's notion of disguised unemployment with the critical minimum effort hypothesis of Leibenstein. Their criterion for a critical minimum effort is that the rate of growth of population must be less than the rate of growth of the industrial labour force. In the presence of disguised unemployment, this condition is always satisfied, provided only that the rate of technological change in the industrial sector is positive. With a positive rate of technological change the rate of growth of the industrial labour force eventually exceeds any fixed rate of growth; with a fixed real wage, measured in agricultural goods, the growth of population is limited by the rate of technological change in the agricultural sector. In the absence of disguised unemployment, the critical minimum effort criterion is satisfied only under a somewhat different set of conditions. We will return to the discussion of this problem after our review of the neo-classical theory.

III. Development of a dual economy: a neo-classical approach[3]

The distinguishing characteristics of the neo-classical theory of the development of a dual economy are the technology of the agricultural sector and the conditions governing the supply of labour. First, in the neo-classical approach it is assumed that the productivity of labour in

[1] Lewis, 1954, pp. 26–27.
[2] Fei and Ranis, 'A theory of economic development', 1961, p. 537.
[3] This section is based on my paper 'The development of a dual economy'.

agriculture is always positive so that labour is never redundant. Secondly it is assumed that the real-wage rate is variable rather than fixed; wage rates in the backward sector are assumed to be proportional to those in the advanced sector. The interpretation of this relationship will be discussed below. Except for the possibility that labour may be redundant, the description of technology for the agricultural sector is the same for both classical and neo-classical theories. In the neo-classical approach there is no level of the agricultural labour force at which the marginal productivity of labour is zero. It is assumed that the agricultural production function for any level of the agricultural labour force may be characterized by the Cobb–Douglas production function:

$$Y = e^{\alpha t} L^{\beta} A^{1-\beta},$$

where variables and parameters have the same interpretation as in the classical approach. Assuming that the supply of land is fixed, this production function may be rewritten in the form:

$$y = e^{\alpha t} A^{-\beta},$$

where $y = Y/A$ is agricultural output per head.

Conditions of production in the manufacturing sector are the same as those of the classical theory. We have assumed that the manufacturing production function may be characterized by constant returns to scale and that the output of manufactured goods for a given quantity of capital and labour increases over time; a simple version of the manufacturing production function is the Cobb–Douglas function:

$$X = e^{\lambda t} K^{\sigma} M^{1-\sigma},$$

where variables and parameters have the same interpretation as in the classical theory. Second, we assume that saving is equal to the share of profits in the manufacturing sector; as before, we ignore depreciation so that the rate of change of capital may be set equal to the share of profits in manufacturing output:

$$\dot{K} = \sigma X.$$

This assumption is identical to that made in the classical approach.

To close the model for the neo-classical theory of the development of a dual economy it is necessary to describe the allocation of labour between the backward and advanced sectors of the economy. To simplify the discussion we will assume that as agricultural output per head increases, all output is consumed up to a level of agricultural output per head equal to the critical value, y^{+}. We assume that once the critical value is attained all further increases in consumption per head take the form of manufactured goods. Under these assumptions agricultural output per head in excess of the critical value, y^{+}, constitutes a surplus; we may define the

agricultural surplus per head, say s, as the difference between agricultural output per head and the critical value, y^+:

$$s = y - y^+.$$

If agricultural output per head exceeds the critical level, part of the labour force may be released from the land to produce manufactured goods with no reduction in the rate of growth of total population.[1]

As before, we denote agricultural population by A and manufacturing population by M; total population, say P, is the sum of these two components:

$$P = A + M.$$

The demographic theory for the development of a dual economy is as follows: The net rate of reproduction is the minimum of the rate corresponding to the minimum force of mortality ϵ and a rate which corresponds to output of food per head; the basic demographic relationship may be written:

$$\frac{\dot{P}}{P} = \min\begin{cases} \gamma y \frac{A}{P} - \delta \\ \epsilon \end{cases}$$

where yA/P is output of food per head for the whole economy and δ is the minimum net reproduction rate equal to the maximum possible force of mortality (mass starvation) and ϵ is a fixed birth-rate that depends on medical technique and social institutions. For an economy with an agricultural surplus, total food consumption is the critical level, y^+, multiplied by total population; the proportion of the total labour force employed in agriculture is the ratio of this critical level of agricultural production per head to the actual level of output per head:

$$\frac{y^+}{y} = \frac{A}{P}.$$

Of course, this relationship holds only when an agricultural surplus exists, that is, if $y > y^+$. Under these assumptions, the relationship governing the distribution of labour between the backward sector and the advanced sector may be represented by:

$$\frac{A}{P} = \min\begin{cases} 1 \\ y^+/y \end{cases}.$$

To study the development of a dual economy for the case in which the

[1] The relationship between the existence of an agricultural surplus and development of the advanced sector has been discussed by Lewis and by Fei and Ranis. This relationship is also discussed by N. Kaldor in his paper, 'Characteristics of economic development', in *Essays on Economic Stability and Growth*. Glencoe: Free Press, 1960, pp. 233–42. The necessity of an agricultural surplus has been emphasized by William H. Nicholls in his papers, 'The place of agriculture in economic development', in Eicher and Witt (eds.), *Agriculture in Economic Development*, pp. 11–44, and 'An agricultural surplus as a factor in economic development', *Journal of Political Economy*, 71 (1963), pp. 1–29.

advanced sector is economically viable, we must assume at the outset that an agricultural surplus eventually emerges, that is, that $\alpha - \beta\epsilon > 0$, which is both necessary and sufficient for the emergence of an agricultural surplus. The case in which the advanced sector is not economically viable will be treated subsequently. We assume first that the initial level of agricultural output per head is below the critical level, y^+. An industrial labour force comes into being when agricultural output per head attains the critical value, y^+, that is, when agricultural output attains the minimum level necessary for population to grow at its maximum rate. From this point forward, population grows at the maximum rate of net reproduction, ϵ.

From the fact that population is growing at a constant rate and that consumption of food per head is stationary, we obtain the following expression for the growth of the agricultural labour force:

$$A = P(0)e^{[\epsilon-\alpha/1-\beta]t} = A(0)e^{[\epsilon-\alpha/1-\beta]t}.$$

Agricultural population may grow, decline, or remain constant, depending on the magnitude of the parameters ϵ, the rate of growth of total population, and α, the rate of technological progress in agriculture.

The manufacturing population is equal to total population less agricultural population; hence the growth of the manufacturing labour force is governed by the following expression:

$$M = P(0)[e^{\epsilon t} - e^{[\epsilon-\alpha/1-\beta]t}],$$

which is zero at time $t = 0$ and grows at a rate which is always more rapid than the rate of growth of total population. To show this we begin with the assumption that an agricultural surplus eventually emerges, namely:

$$\alpha - \beta\epsilon > 0,$$

which implies:

$$\epsilon - \alpha < \epsilon(1-\beta),$$

so that:

$$\epsilon > \frac{\epsilon-\alpha}{1-\beta}.$$

The rate of growth of population is greater than that of the agricultural population alone; hence the manufacturing labour force is growing at a rate which exceeds that of total population. The rate of growth of the manufacturing labour force is always declining and approaches, as a limit, the rate of growth of population, ϵ.

To study the growth of manufacturing output, it is necessary to characterize the process of capital accumulation in the advanced sector of the economy. The fundamental relationships include the expression given above for the growth of the manufacturing labour force, the production function for the manufacturing sector, and the savings function. Combining these relationships we may eliminate the output of the manufacturing

sector and the manufacturing labour force to obtain a differential equation in capital alone:

$$\dot{K} = \sigma K^{\sigma} P(0)^{1-\sigma} e^{\lambda t}[e^{\epsilon t} - e^{[\epsilon-\alpha/1-\beta]t}]^{1-\sigma},$$

which is the fundamental differential equation for the neo-classical theory of development of a dual economy. From this fundamental equation it may be deduced immediately that there is no stationary situation for any economy in which the advanced sector is economically viable; that is, provided that there is a positive and growing agricultural surplus, the advanced sector must continue to grow. The pattern of growth of the advanced sector is determined by two initial conditions, the size of total population at the time that the growth of the advanced sector begins and the size of the initial capital stock. Only the initial size of the population has any effect on the long-run pattern of growth of the economy; the influence of the initial size of capital stock eventually dies out.[1] Secondly, it may be shown that there is no critical minimum level of the initial capital stock required for sustained economic growth. Given any positive initial capital stock, no matter how small, the existence of a positive and growing agricultural surplus generates sustained economic growth.

For the neo-classical theory of the development of a dual economy capital and output grow at the same rate in the long run, namely, $\lambda/(1-\sigma)+\epsilon$, where λ is the rate of technological progress in industry, $1-\sigma$ is the share of labour in manufacturing output, and ϵ is the rate of growth of population. Population grows at the rate ϵ; since the share of labour in manufacturing output is constant, the wage rate of the manufacturing labour force eventually grows at the rate $\lambda/1-\sigma$. In the short run the beginning of the growth of the advanced sector is always characterized by a 'big push', that is, an extraordinarily high rate of growth of manufacturing output. From the viewpoint of the neo-classical theory of the development of a dual economy, such a high initial rate of growth may be interpreted as a statistical artifact. Using the production function for the advanced sector, we may derive the relation:

$$\frac{\dot{X}}{X} = \lambda + \sigma\frac{\dot{K}}{K} + (1-\sigma)\frac{\dot{M}}{M}$$

so that the rate of growth of manufacturing output is equal to the rate of technological progress plus a weighted average of the rates of growth of capital stock and of the manufacturing labour force. But the initial rate of growth of the manufacturing labour force is essentially unbounded; this rate of growth declines gradually, approaching a long-run equilibrium value equal to the rate of growth of total population. The existence of a statistically observable 'big push' is no evidence for the necessity of a

[1] A proof of this proposition is given in 'The development of a dual economy', pp. 330–3.

massive infusion of capital from outside the system for a 'take-off' into sustained growth; sustained growth depends on the economic viability of the advanced sector and not on the initial level of capital stock. The advanced sector is economically viable if and only if there is a positive and growing agricultural surplus.

We have assumed that wage rates in the backward sector of a dual economy are proportional to those in the advanced sector. Using this relationship and the saving function it is possible to determine the terms of trade between agriculture and industry. The balance of trade between agriculture and industry requires that the value of labour income in both sectors is equal to the value of manufacturing output not used for additions to capital together with the value of total agricultural output. This balance relation may be written:

$$wM+\mu wA = (1-\sigma)X+qY,$$

where q is the terms of trade between agriculture and industry and μ is the constant of proportionality between wage rates in the agricultural sector and wage rates in the industrial sector.

The constant of proportionality may be interpreted in a number of different ways. First, in a 'strict' neo-classical theory wage rates in the two sectors must be equal. In this case the constant of proportionality, μ, is unity. Alternatively, if the process of development of a dual economy is characterized by a steady flow of labour from agriculture to industry, a differential between agricultural and industrial wages may be required to sustain this flow.[1] As a third alternative, if land is owned by the cultivators but the full value of the land cannot be realized by outright sale, the industrial wage rate must be sufficiently high to cover both labour and property income for a member of the agricultural labour force.[2] If nothing can be realized by the sale of land, the industrial wage rate would have to be equal to unity divided by the share of labour in total agricultural output. Other interpretations of the constant of proportionality could doubtless be given. Provided that μ is a fixed constant the balance relation may be rewritten in the form:

$$\mu wA = qY,$$

so that:

$$\frac{\dot{w}}{w}+\frac{\dot{A}}{A} = \frac{\dot{q}}{q}+\frac{\dot{Y}}{Y}$$

and:

$$\frac{\dot{q}}{q} = \left[\frac{\epsilon-\alpha}{1-\beta}-\epsilon\right]+\frac{\dot{w}}{w}.$$

In the long run the rate of growth of the wage rate in manufacturing is equal to $\lambda/1-\sigma$, so that the rate of growth of the terms of trade is the sum

[1] See, for example, 'The development of a dual economy', pp. 322–3.

[2] Lewis, 1954, pp. 148–9.

of a negative and a positive quantity; hence the terms of trade may turn in favour of agriculture or industry, depending on the relative magnitude of the two quantities.

IV. Beyond disguised unemployment

Where the advanced sector is already in existence, wage rates in the advanced and backward sectors may be taken to be equal, as in the 'strict' neo-classical approach. Then the neo-classical theory of the development of a dual economy may be reinterpreted as a theory of the neo-classical phase of Lewis's theory of economic development. The growth of the manufacturing labour force and manufacturing output and the accumulation of capital are described by the relations given above for the neo-classical theory. However, the initial phases of the development of the advanced sector are not the same as in the neo-classical theory. In the classical theory the phase of redundant labour initiates the development of manufacturing. This sector develops further in the phase of disguised unemployment, where there is no redundant labour but the marginal product of labour in the agricultural sector is below the real wage rate, measured in agricultural goods. Finally, the marginal products of labour in both sectors are brought into equality with the fixed real-wage rate. By this time a certain amount of capital has been accumulated in the manufacturing sector. Given the manufacturing labour force, the second initial condition for the fundamental relations of the neo-classical theory of development of a dual economy, namely, the size of total population when agricultural output per head reaches its critical value, y^+, can be computed by inserting the manufacturing labour force into the equation:

$$M(t) = P(0)[e^{\epsilon t} - e^{[\epsilon - \alpha/1-\beta]t}],$$

by inserting total population into the equation:

$$P(t) = P(0)e^{\epsilon t},$$

and by computing $P(0)$ and the origin for the measurement of time. These constants may then be used to determine the course of economic growth in the neo-classical phase of the classical theory of the development of a dual economy. Of course, the fundamental relations of the neo-classical theory are valid for the classical theory only *after* the beginning of the neo-classical phase.

Up to this point we have considered only the case in which the advanced sector is economically viable. A necessary and sufficient condition for the economic viability of the advanced sector is the eventual emergence of a positive and growing agricultural surplus. Provided that an agricultural surplus eventually emerges, the development of a dual economy may be characterized in two ways. If there is disguised unemployment as in the

classical approach, the manufacturing sector develops in three separate phases. First, manufacturing output and employment grow at a rate which is positive and increasing. Capital in manufacturing also grows at a rate which is positive and increasing, but always less than the rate of growth of manufacturing output. Redundant labour eventually disappears. Secondly, provided that the share of manufacturing in the total labour force exceeds the elasticity of agricultural output with respect to land, the agricultural labour force declines at an increasing rate until the marginal product of labour is equal to the real wage in both sectors. The realization of this condition marks the end of disguised unemployment. Finally, the manufacturing sector enters on to the neo-classical phase. This phase is the same as the phase of 'dualistic' development in the neo-classical theory, provided that the initial conditions of the fundamental relations of the neo-classical theory are properly reinterpreted. If there is no disguised unemployment as in the neo-classical approach, the backward sector develops according to the fundamental relations describing an increase in agricultural output per head until the critical level, y^+, is reached. At this level the force of mortality reaches its minimum and the net reproduction rate for total population reaches its maximum. From this point forward the development of the manufacturing sector is described by the fundamental relations for capital accumulation and for the growth of manufacturing output and employment. These relations are the same as those describing the neo-classical phase of development of a dual economy in the classical approach.

We may now consider the case in which the advanced sector is not economically viable. First, we will describe the neo-classical theory of development for this case. If capital for the advanced sector is already in existence, the condition for economic viability of this sector, $\alpha - \beta\epsilon > 0$, is not satisfied. There are two possibilities. First, suppose that $\alpha = \beta\epsilon$; then the manufacturing labour force is equal to zero and there is no manufacturing production. Secondly, suppose that $\alpha < \beta\epsilon$ and the initial value of the manufacturing labour force is positive. Then this labour force declines to zero after which there is no further manufacturing production. Total population becomes entirely concentrated in the agricultural sector and agricultural output per head eventually declines to that associated with the low-level equilibrium trap.

The classical theory of development where the advanced sector is not economically viable at the maximum net reproduction rate is somewhat more complex. We consider development only in the third or neo-classical phase. In this phase the development of a dual economy is characterized by the same fundamental relations as in the neo-classical approach. If the advanced sector is not economically viable, two possibilities exist.

First, if $\alpha = \beta\epsilon$, the existence of a positive manufacturing labour force contradicts the fundamental differential equation for the neo-classical theory of development of a dual economy. Hence, for the classical approach this condition must be ruled out by assumption. Secondly, if $\alpha < \beta\epsilon$, the manufacturing labour force begins to decline as soon as disguised unemployment is eliminated. This decline continues until the agricultural labour force reaches its maximum level, so that further increases in the agricultural labour force are redundant. Throughout the decline of the manufacturing labour force the real wage in both sectors remains constant with no disguised unemployment.

With a fixed real wage, measured in agricultural goods, the rate of population growth must decline to the rate of technological progress in agriculture when the agricultural labour force reaches its maximum, so that $\epsilon = \alpha$ from this point forward. At this lower rate of population growth the advanced sector is always economically viable. The labour force in manufacturing begins to grow at a rate exceeding that of population growth, but eventually declines to this rate of growth. The renewed growth of the manufacturing labour force is characterized by a 'big push', that is, an extraordinarily high rate of growth of the manufacturing labour force. As in the neo-classical theory of the development of a dual economy, this high initial rate of growth may be interpreted as a statistical artifact. The existence of such a statistically observable 'big push' is no evidence for the necessity of a massive infusion of capital from outside the system for a 'take-off'. Sustained growth depends on the economic viability of the advanced sector at the new rate of population growth and not on the initial level of capital stock.

In the second phase of growth in the manufacturing labour force the labour force in agriculture remains constant at its maximum level, while agricultural output grows at the same rate as population. Manufacturing output and capital stock eventually increase at the rate $\lambda/(1-\sigma)+\alpha$ and the real wage, measured in manufacturing goods, grows at the rate $\lambda/1-\sigma$. Throughout the second phase of growth in the manufacturing labour force, the real wage, measured in agricultural goods, is increasing at the rate of technological progress in agriculture, α. The terms of trade between agriculture and industry eventually grows at the rate $\lambda/(1-\sigma)-\alpha$. This rate may be positive or negative, depending on the relative rates of technological progress in the two sectors.

In the classical theory of the development of a dual economy the phase of development beginning with no manufacturing production but with redundant agricultural labour or disguised unemployment is characterized by a rate of growth of the manufacturing labour force that exceeds the rate of growth of population. This characterization is a necessary

consequence of the classical theory whether or not the advanced sector is economically viable at the maximum rate of net reproduction. If the advanced sector is not economically viable at this rate of population growth, the initial phase of disguised unemployment is followed by a phase of absolute decline in the manufacturing labour force that terminates with the agricultural labour force at its maximum level and with a reduced rate of population growth. This phase is followed by a second phase of growth in the manufacturing labour force. Again, the rate of growth of the manufacturing labour force exceeds the rate of growth of population.

We conclude that the criterion for a critical minimum effort proposed by Fei and Ranis, that the rate of growth of population must be less than the rate of growth of the industrial labour force, provides no indication whatever concerning the economic viability of the advanced sector. The advanced sector is economically viable if and only if there is a positive and growing agricultural surplus, that is $\alpha > \beta\epsilon$. During the phase of disguised unemployment, the critical minimum effort criterion of Fei and Ranis is satisfied whether or not the advanced sector is economically viable. Where their criterion is satisfied, the elimination of disguised unemployment may be followed by sustained economic growth or by a period of absolute decline in the manufacturing labour force. Only the existence of a positive and growing agricultural surplus assures that growth will be sustained.

V. Summary and conclusion

In the preceding sections we have described two alternative approaches to the theory of development of a dual economy. In order to facilitate comparison of the two approaches, we have attempted to develop both within the same framework. Within this framework the basic differences between the two approaches are in assumptions made about the technology of the agricultural sector and about conditions governing the supply of labour. In the classical approach it is assumed that there is some level of the agricultural labour force beyond which further increments in this labour force are redundant. In the neo-classical approach the marginal productivity of labour in agriculture is assumed to be always positive so that labour is never redundant. In the classical approach the real-wage rate, measured in agricultural goods, is assumed to be fixed 'institutionally' so long as there is disguised unemployment in the agricultural sector. In the neo-classical approach the real-wage rate is assumed to be variable rather than fixed; it is further assumed that at very low levels of income the rate of growth of population depends on the level of income. These are the basic differences between the neo-classical and classical approaches to the theory of development of a dual economy.

The neo-classical and classical theories differ in the characterization of the backward or traditional sector of the economy. These differences have implications for the behaviour of the backward sector. Among the implications we may note that according to the classical approach, the agricultural labour force must decline absolutely before the end of the phase of disguised unemployment; in the neo-classical approach the agricultural labour force may rise, fall, or remain constant. The differences between the two approaches also have implications for the behaviour of the advanced sector; unfortunately, these implications depend on the actual behaviour of the terms of trade between the backward and advanced sectors. In the neo-classical approach the terms of trade may rise or fall. In the classical approach the terms of trade cannot be determined endogenously. Alternative assumptions about the course of the terms of trade may be made. Corresponding to each assumption about the terms of trade, there is an alternative theory for the behaviour of the advanced sector. Since any assumption about the course of the terms of trade is consistent with the classical approach, the behaviour of the terms of trade cannot provide a test of this approach. The classical approach may be tested only by deriving the implications of this approach for the advanced sector, given the observed behaviour of the terms of trade, and confronting these implications with empirical evidence.

We have developed the classical theory in detail only on the assumption that the terms of trade between the backward and advanced sectors remain constant. Proceeding on this assumption, we have derived the following implications of the classical approach: (1) output and employment in the advanced sector grow at the same rate so long as there is disguised unemployment in the backward sector; that is, labour productivity in the advanced sector remains constant; (2) capital grows at a slower rate than output and labour so that capital-output ratio falls; this result corresponds to that of Fei and Ranis;[1] (3) the rates of growth of manufacturing output, employment, and capital increase during the phase of disguised unemployment. For the neo-classical approach, the corresponding results are: (1) output and capital in the advanced sector grow at the same rate, asymptotically, so that the capital-output ratio remains constant; (2) manufacturing employment grows more slowly than either output or capital so that labour productivity in the advanced sector rises; (3) the rates of growth of manufacturing output and employment decrease throughout the development process. Since the classical approach reduces to the neo-classical approach after the phase of disguised unemployment is completed, the two approaches have different implications only for situations where it is alleged that disguised unemployment exists.

[1] Fei and Ranis, 1963, p. 288.

In view of the similarities between classical and neo-classical approaches to the development of a dual economy it is not surprising that many implications of one model are also implications of the other. For example, both models imply that if the proportion of manufacturing output to agricultural output increases, the share of saving in total income also increases. Thus, either model suffices to explain an increase in the fraction of income saved in the course of economic development. The fact that the implications of the two approaches for the share of saving are identical is of considerable significance. According to Lewis: 'The central problem in the theory of economic development is to understand the process by which a community which was previously saving and investing [four or five per cent.] of its national income or less, converts itself into an economy where voluntary saving is running at about [twelve to fifteen per cent.] of national income or more. This is the central problem because the central fact of economic development is rapid capital accumulation (including knowledge and skills with capital).'[1] Both classical and neo-classical theories of the development of a dual economy provide an explanation of an increase in the share of saving. In each case the explanation is based on the relationship between saving and industrial profits. Disguised unemployment is neither necessary nor sufficient to generate a sustained rise in the share of saving. Ultimately, a sustained increase in the saving share depends on a positive and growing agricultural surplus and not on the presence or absence of disguised unemployment.

The role of the industrial sector in economic development is critical for the elimination of disguised unemployment. In the absence of industrialization an economy with redundant labour is characterized by population growth at a rate equal to the rate of growth of agricultural output. Agricultural output grows at the rate of technological progress in agriculture. All increments in population become part of the redundant labour force. In the presence of industrialization the rate of growth of manufacturing employment eventually becomes so large as to force the rate of growth of redundant labour to become negative; redundant labour eventually disappears altogether. The disappearance of disguised unemployment is, however, no indication that the industrial sector is economically viable. If the condition for persistence of an agricultural surplus is not satisfied, the initial phase of disguised unemployment is followed by a phase of absolute decline in the manufacturing labour force that terminates with the agricultural labour force at its maximum level and with a reduced rate of population growth. The condition that population grows more slowly than the manufacturing labour force provides no indication of the economic viability of the advanced sector at a given rate of population growth.

[1] Lewis, 1954, p. 155.

In the theory of development of a dual economy, there is no critical minimum level of initial capital stock required for sustained economic growth. Given any positive initial capital stock, no matter how small, the existence of a positive and growing agricultural surplus generates sustained growth of the industrial sector. In the long run the development of a dual economy is characterized by a growth in industrial output at a rate equal to the sum of the rate of growth of population and the ratio of the rate of technological progress in industry to the share of labour in that sector. Agricultural output grows at a rate equal to the rate of growth of population; hence the ratio of industrial output to agricultural output is always increasing. Similarly, the rate of growth of the industrial labour force is equal to the rate of growth of population in the long run. The rate of growth of the agricultural labour force is equal to the difference between the rate of growth of total population and the rate of technological progress in agriculture divided by the share of labour in agriculture. The existence of a positive and growing agricultural surplus assures that this rate of growth is less than that of population; accordingly, the ratio of industrial labour force to agricultural labour force is always increasing. Finally, capital and output in the industrial sector eventually grow at the same rate so that capital per man increases at a rate equal to the rate of growth of output per man, namely, the rate of technological progress in industry divided by labour's share in industry. The share of capital formation in national product is always increasing, ultimately approaching the share of property in the product of the industrial sector.

We conclude that the industrial sector plays a strategic role in the development of a dual economy with or without disguised unemployment. Industrial output and industrial labour force ultimately come to dominate a developed economy as a consequence of the shift in a consumer demand from agricultural to industrial products and as a result of the rising proportion of investment demand in total output as income *per capita* increases. However, supply conditions for the agricultural sector must not be neglected in any analysis of prospects for industrialization. Unless technological progress in agriculture is sufficiently rapid to outpace the growth of population and the force of diminishing returns, the industrial sector may not be economically viable.

In the absence of a growing agricultural surplus, forced industrialization at fixed real wages may result in a phase of growth in the relative importance of industry with no improvement in levels of living, followed by an absolute reduction in the size of the industrial sector as population growth is forced down to the Malthusian level consistent with the increase of sustenance. Since the criterion for the persistence of an agricultural surplus depends on the rate of growth of population, the rate of advance of agricultural

technology required for improvement in levels of living is larger the larger the rate of population growth. The recent increase of rates of population growth in low-income countries has increased the threshold for rates of improvement in agricultural technology required to sustain industrial development. Where the condition for viability of the industrial sector is not met, any policy for industrialization must be accompanied by policies for population control and for the introduction of non-traditional factors into the agricultural sector.[1]

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[1] T. W. Schultz, *Transforming Traditional Agriculture*. New Haven: Yale University Press, 1964. The importance of policies of this type for low-income countries has been emphasized by Schultz in this book.